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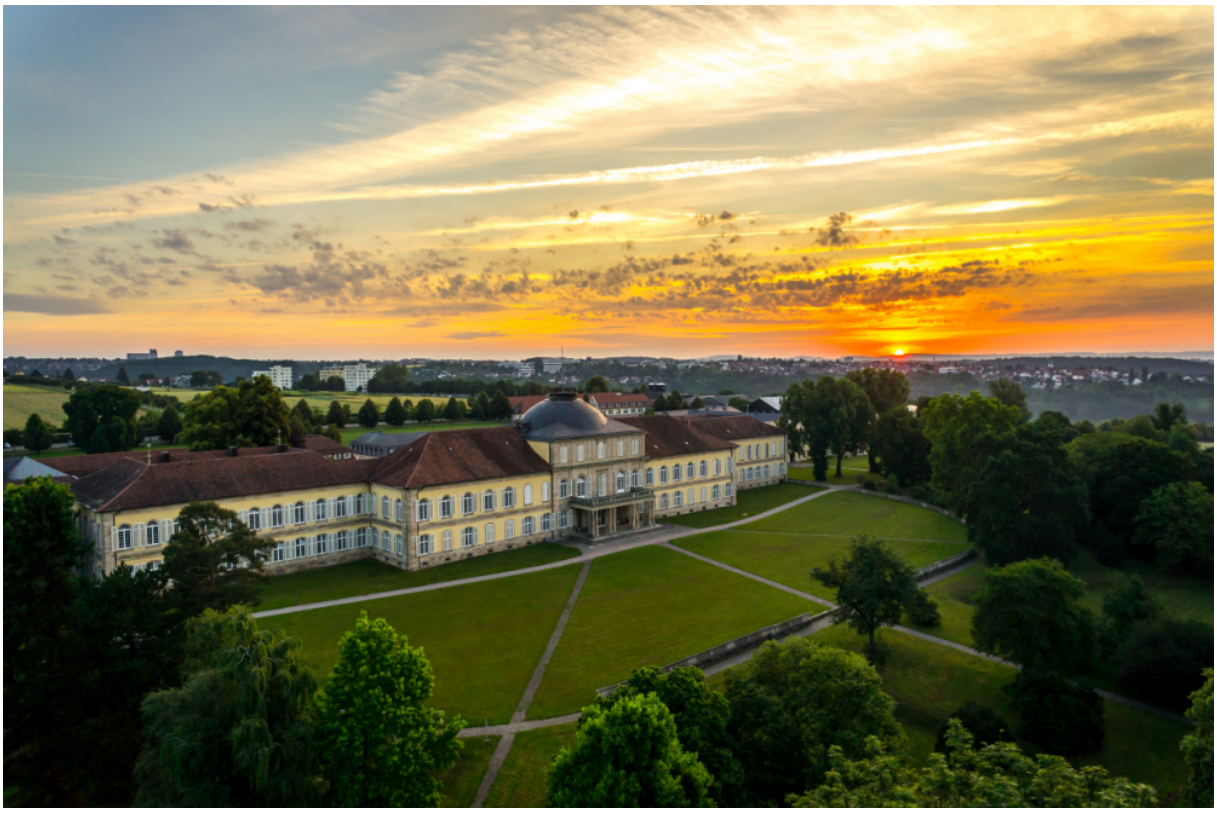

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Session “Weed Diversity and Farming Systems”

Development of the arable vegetation 23 years after the change from conventional to organic farming – experiences on a farm scale

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Recent meta-analyses assessing the impact of organic farming on plant species diversity showed that positive effects mainly occurred at a small scale while benefits at the farm or landscape level were less pronounced. The authors also detected that common species were more favored by organic farming than rare ones.
In a farm scale study we analyzed how the introduction of organic farming changed arable plant communities over a 23 year period and questioned the impact on weed management and species conservation. Generalized linear models were used to analyze vegetation changes, models including environmental variables were not possible due to incomplete data. After 23 years of organic farming crop cover slightly decreased but yields of winter cereals (5.2 t/ha) still achieved 78% of the pre-organic harvest. Arable plant cover increased from 2 to 40% and the soil seed banks enlarged from 4.200 to 33.300 seeds/m². Numbers of plant species increased by 46% at the plot and 22% at the farm scale. Plant species characteristic of arable fields increased by 50% and 19%, respectively. Populations of both threatened and problematic species clearly profited from the conversion. Our results confirm that organic farming benefits overall plant biodiversity. Characteristic species and rare arable plants profited more at the plot scale, however, effects were also visible at the farm level. A significant increase in the cover of insect pollinated plants indicates that organic field management can substantially support provisioning of ecosystem services. Our data proof that long-term organic farming can increase nature conservation value of the arable flora without a serious setback of crop yields.

Preserving weed biodiversity: The role of precision agriculture technologies

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EFSA's Scientific Opinion addressing the risk assessment of plant protection products for non-target terrestrial plants was published in 2014. The Opinion defines non-target plants as all plants growing outside fields and those growing within fields that are not the intended pesticide target. These species provide valuable ecosystem services including food web support, aesthetic value and biodiversity. Although approaches for protecting these species have been discussed in various stakeholder workshops since 2014, such debates rarely consider advances in precision agriculture techniques that have the potential to modify the way in which herbicides are applied in the future. Increasing precision enablement of crop sprayers includes the use of GPS systems, boom section control and pressure variation, so enabling variable applications across fields. Meanwhile, increased understanding of the environmental factors driving target weed distributions allows development of field-specific weed maps. Combination of these approaches will enable patch spraying whereby only the infested areas of fields are treated thereby reducing total herbicide usage. Furthermore, this technology can be used to facilitate the maintenance of untreated, vegetated areas within or alongside fields, thereby contributing to the preservation of natural or sown beneficial plant communities within agricultural landscapes. This presentation aims to raise awareness of the potential use of precision technologies to facilitate the preservation of weed biodiversity and will highlight the need to retain access to the necessary herbicide products by developing regulatory risk assessment processes that accommodate the use of these technologies.

A landscape-scale approach for linking farming strategies to weed communities and their contribution to ecosystem services

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Weeds provide trophic resources and contribute to the provision of ecosystem services such as pollination (pollen and nectar in flowers) and biological control (seeds for pest antagonists). The nature and level of services provided depends on the composition of weed communities and this composition is driven by the combination of different farming practices. Linking farming strategies to services is thus an important step to provide management guidelines for enhancing ecosystem services. We report here on such an analysis, based on agronomical and weed data collected annually in 70 field cores and field edges of any crop between 2008 and 2013 on the Fénay landscape platform, a 1000 ha area with arable farming located near Dijon (Eastern France). Our results indicate that across this study area, farmers adopted contrasting farming strategies and that the observed differences in field management practices led to differences in the composition of weed communities. Our data also show that weed species number and weed community composition strongly differ between habitats, i.e. in average 16 species in field edges and only 6 in the core of fields. A phenological survey of the most frequent weeds was set up to estimate their success in providing flower and seed resources during the crop growing season. We expect this success to differ between field cores and field edges and between contrasting field management strategies. Indices of services provision for observed weed communities will be derived from the recorded abundance of species and their success in providing trophic resources under different habitats and management strategies evaluated.

The contribution of spatial mass effects to plant diversity in arable fields

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In arable fields, plant species richness consistently increases towards the field edges. This potentially makes the field edge an important habitat for the conservation of weeds and the invertebrates and birds they support. Increased diversity and abundance of weeds in crop edges could be owing to either a reduction in agricultural inputs toward the field edge and/or spatial mass effects associated with dispersal from the surrounding landscape.

We analysed a large dataset of conventionally managed arable fields in the UK to study the effect of the immediate landscape on in-field plant diversity and abundance and to quantify the contribution of spatial mass effects to plant diversity in arable fields. We demonstrated that the decline in diversity with distance into an arable field is highly dependent on the immediate landscape, indicating the important role of spatial mass effects in explaining the increased species richness at field edges in conventionally managed fields.

Conserving the ruderal arable plant community, and the invertebrates and birds that use it as a resource, in conventionally managed fields typically relies on the targeted reduction of fertilisers and herbicides in conservation headlands. The success of these options will depend on the neighbouring habitat and boundary. They should be placed along margins where the potential for ingress of competitive species, that may become dominant in the absence of herbicides, is limited. This will enhance ecosystem services delivered by the ruderal flora and reduce the risk of competitive species occurring in the crop.

Steering weed species community using sown wildflowers

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To enhance biodiversity mixtures of wildflowers (WF) are sown into maize fields. Within the micro-segregation approach WF are sown between maize rows to form stable habitat-strips and the WF are the only weed management of the habitat-strips.
Together with weeds and crops they form plant community on these fields. WF are selected mixtures and thus are part of the management and sometimes even part of the weed control.
We analyzed the effect of sown WF on the weeds: the performance in terms of suppression of weeds as well as their effects on shaping the weed species community. For the analysis we use data of a one-year field trial on two sites, were a mixture of 28 plant species was used. These plants were considered week competitors to maize.
We found a strong effect of the experimental site on both, the weeds and the WF. The density of weeds in relation to the density of WF was dominated by weeds at one site and by WF at the other. Specific species, weeds as well as WF dominated some plots. While the WF were able to form an even plant community at one site it fails partly on the other, where some plots were dominated by specific species. This highlights the importance of flexibility and adaptation of WF mixtures to the site.

Session “Weed Surveys and Databases”

Weed species composition of oil pumpkin fields in Hungary

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Oil pumpkin is a major emerging alternative crop with several unresolved weed management questions in central-eastern Europe, one of the focal regions of oil pumpkin production worldwide. This study aims to assess the importance of three groups of factors: environment, non-chemical management (all management excluding herbicides), and chemical weed management, in determining the weed species composition of oil pumpkin crops in Hungary. We surveyed the weed flora of 180 oil pumpkin fields across the country, along with 32 background variables. Applying a minimal adequate model consisting of 18 terms with significant net effects, 30.8% of the total variation in weed species data could be explained. Most variation in species composition was determined by environmental factors, with climatic conditions (precipitation and temperature) being most influential. The net effects of seven non-chemical management variables (preceding crop, N and P fertilisers, seeding rate, crop cover, cultivating tillage, and manual weed control), and two herbicides (S-metolachlor and linuron) were also significant. Variation partitioning demonstrated the dominance of environmental factors, and it also showed that non-chemical management practices accounted for five times more variance than herbicides. Within non-chemical management, the relative impact of cultural variables was nearly five times larger than that of mechanical weed management. Although the short stature of pumpkin with its poor weed-suppressive ability could unfavourably influence the results of some cultural practices, our findings suggest that the weed vegetation of oil pumpkin fields can be efficiently managed also with environmentally benign methods.

Variables influencing the abundance of *Ambrosia artemisiifolia* in the Austrian-Hungarian borderland

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The Pannonian Plain is one of the focal regions of the invasion of *Ambrosia artemisiifolia* in Europe. The main goal of this study was to assess whether any different infestation patterns and their drivers could be identified in its western periphery between the borderlands of Austria and Hungary. The abundance of *A. artemisiifolia* was measured in 200 arable fields across the region, along with 31 background variables. Data were analysed by using binomial generalized linear models as well as by classification and regression tree models. *A. artemisiifolia* occurred more frequently in Hungary, but there were no significant differences in the proportion of larger cover values between the countries, and 'cover values > 10%' were even slightly more common in Austria. Maize and soyabean as previous crops as well as conventional farming were responsible for higher abundances in Austria, while organic farming was associated with relatively higher frequencies of heavy infestations in Hungarian fields. Regarding the general predictors irrespective of the countries, crop cover has proven to be the most important variable indicating larger abundances if it was lower than 35-65%. Although we managed to identify some country-dependent variables causing different infestation patterns, low crop cover appeared to be the most powerful general predictor responsible for the high infestations.
This work was supported by 'Joint Ambrosia Action ATHU51' Interreg project.

Using functional traits to model plant communities in arable fields

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Predicting the response of weed communities to changes in the environment or management is a key goal if we are to reconcile the competing objectives of weed management and reduce yield loss from weeds whilst supporting ecosystem service delivery. Predictions of this kind can be made by considering the outcome of several filters acting on the community, with species poorly adapted to the changing conditions removed from the local species pool according to their functional trait attributes. In contrast, community dynamics models can be used to look at the responses of small numbers of species in finer detail – however, the parameterisation requirements of these models makes them unmanageable for large numbers of species.

We developed a model which combines these two approaches to predict changes in community composition. We parameterised each mechanistic process in a generic annual plant life-cycle model for multiple species by describing trade-offs and correlations among plant traits.

To evaluate the performance of our trait-based community model we identified a field, with known cropping, tillage, and fertiliser input history for 30 years. These management data together with weather data for the site, were used as inputs for the model and act as the environmental and management filters. We compared predictions from our trait-based community model with the weed community observed in the field.

We demonstrated that by parameterising a process-based model using data from well-studied plant traits we ca model the effect of environmental filters on arable plant communities. In all our simulations, the direction of selection was consistent with in-field observations.

Organisation of data rights within a collection of weed vegetation surveys

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Within the EWRS, numerous scientists have undertaken weed vegetation surveys in their regions and countries. Beside the initiatives to join these survey data for further analyses on a continental scale it was proposed to make the data collection publicly accessible to the wider scientific community. Well known examples for such public data bases are TRY on plant traits or GBIF on vegetation occurrence data. Some researchers may still be reluctant to make their data openly accessible, fearing the unauthorised use, and giving their work away uncredited.

The presentation will give an overview how data rights and permissions are managed in VegetWeb, a large German vegetation data base. Data contributors can choose between three different levels of data access for users:
1) free data: data are open access to any user asking for data,
2) protected data: contributors are asked for permission for each request of their data
3) blocked data: data reference is publicly visible, but data can't be requested via the platform.
Data access is combined with a list of references that need to be cited when using the data.

Benefits of this kind of data rights management are: proper credit to primary data providers, providers choose level of control of their data, and the direct citation of the data is made possible.

Session “Rare arable weed species”

How can we improve effectiveness and uptake of arable plant options in agri-environment schemes?

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Arable intensification had pronounced effects on the arable flora in the UK and in continental Europe, resulting in a severe decline of many species. Thus, targeted options were included in UK agri-environment schemes that focused on field margins and encouraged extensive management of cropped margins ('conservation headlands'), or removal of land from cropping ('uncropped cultivated field margins'). However, farmer participation in schemes is voluntary, and uptake of such options has been affected by farmers' perception of a risk of weed infestation.

We carried out a research project to provide recommendations for scheme options for rare arable plants, to improve their uptake by farmers and overall delivery. One question we addressed was how uncropped margins can be managed optimally for rare arable plants whilst enabling farmers to prevent build-up of undesirable weeds. In a four-year experiment at three sites, we explored effects of seasonal timing, method of cultivation and potential of selective herbicides for achieving these objectives.

Rare species showed preferences in terms of cultivation season, but many were not entirely restricted to either spring or autumn emergence. For many species, establishment was unaffected by cultivation depth. However, in some species such as for example the rare cornsalad species *Valerianella dentata* and *V. rimosa*, ploughing in the preferred season promoted establishment compared to shallow cultivation. Build-up of undesirable grass weeds varied between cultivation treatments, generally being strongest with shallow cultivation, particularly in autumn. Graminicides achieved good control of grass weeds, while leaving populations of rare arable broadleaf species unharmed. Selective broadleaf herbicides carried a greater risk for these species.
Based on the findings of our study, we were able to make a number of recommendations to help inform next-generation agri-environment scheme options for rare arable species

Impact of crop density, crop type and soil tillage on reintroduction of rare arable plants in three-year crop rotations

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The vegetation of arable fields has changed dramatically in the past decades with great losses in abundance and diversity of arable plants. In addition to preserving remnant populations, the introduction of autochthonous seeds is a promising measure to promote threatened plant species and to restore agro-ecosystems. However, knowledge about suitable establishment conditions and agricultural management for sown species is scarce.

Therefore, the impact of different three-year crop rotations on establishment of three winter annuals (*Legousia speculum-veneris*, *Consolida regalis*, *Lithospermum arvense*) was investigated. We established 14 treatments with five repetitions in a Latin square design on an organic farm near Munich, Germany. In the first year, arable plants were sown in a mixture of 850 seeds m^{-2} in different crop types (spelt, rye) and crop sowing densities (0%, 25%, 100%). After crop harvest different soil tillage was applied (harrow vs. plough). In the second year four different crop types (autumn sown spelt, spring sown triticale, pea, clover-grass) and in the third year rye were cultivated.

Overall, establishment was highest in *L. speculum-veneris*, followed by *C. regalis* and *L. arvense* being highly correlated with cover of crops and weeds during the study period. Initial crop sowing densities led to significant differences in establishment of the study species, with persisting effects in the second and third year. In plots without crop rare arable plants established better than at 25% and 100% spelt sowing density. Density and seed production of rare arable plants in the second year were significantly affected by crop type (spelt>triticale>pea>clover-grass), but not soil tillage. In the third year seed production of *L. speculum-veneris* was in all plots up to 370 times higher than initial sowing rate. Seed production of *C. regalis* increased up to 60 times, but decreased in crop rotations with clover-grass; *L. arvense* decreased in all plots. These results were confirmed by seed bank analyses.

Our study demonstrates that reintroduction of rare arable plants can be implemented in different crop rotations, with best results in extensively managed fields with low crop competition.

Changes in floral composition of segetal communities of cereal crops in Poland

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The opinion on the importance of weeds has been changing over time. The role played by plants usually called conventional weeds among agriculture scientists is currently reevaluated and assessed to understand their significance in agroecosystems. This paper presents the distribution of cereal field weeds in the South of Poland, as well as their diversity depending on habitat and methods of management, their importance, as well as the protection strategy for rare arable plant species. Extensive farming, limestone soil and the proximity of fields to the xerothermic plants reserve favours species diversity of weeds in Southern Poland. Research was carried out in one of Poland's most abundant and oldest agricultural areas in the south of the country, between 1995-1999, and repeated in 2004-2005 and in 2014-2015. A significant part of research was conducted on limestone soil, as this soil type is characteristic of the unique weed species of the community *Caucalido-Scandicetum*, threatened by extinction both in Poland and Europe. Results were compared with literature of previous research conducted in the 70's, between 1986-1988 and 2000-2001. Phytosociological records performed in cereal crop fields were compared. All records were made according to the Braun-Blanquet method of vegetation surveying. The results showed that some of the threatened weed species that were still occurring in the 70's have become extinct or were significantly reduced in their numbers in the 80's, 90's and 2000. In contrast, some common species have become more dominant in the weed community. This is mostly due to the method of management and particularly the intensive use of herbicides which was observed during the last 30-40 years in Poland. Recently, many farmers have switched to ecological farming and discontinue using herbicides.

Session: “Biotic Interactions and Seed Predation”

Predation of weed seeds (*Echinochloa crus-galli*) in spring cereals in SE Norway

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In a field trial in spring cereals conducted across four site-years at Ås, SE Norway, we estimated the natural predation rate of *Echinochloa crus-galli* (ECHCG) and *Chenopodium album* seeds on the soil surface. Here we report only the ECHCG results.

The number of missing seeds divided by the initial seed numbers at seed cards was used to estimate the predation rate during four periods; Crop closure (T1), Pre-harvest (T2), Early and Late post-harvest (T3 and T4). Half of the cards were inside cages (mesh size 12×12-mm^2) which prevented larger granivores to enter, while local invertebrates could pass freely. Seed cards were placed in a 10-m×20-m grid (5 transects with 4 cards each, 10 m between cards, 20 m between transects, card type (weed species, ± cage) randomized within transect). In two of the site-years, four pitfall traps were present during each period (along a diagonal across the grid).

The mean predation rates were higher for cards without *versus* inside cages: about 20% (T1, T3), 30% (T4) and 50% (T2) *versus* about 2% (T1, T2), 5% (T4) and 13% (T3), respectively. Hence, granivores larger than the local invertebrates are important in biological control of ECHCG in SE Norway. Potential local «large» granivores are rodents (Muroidea spp.) and birds (Passeriformes spp., Columbidae spp.). The most frequent granivorous and omnivorous carabid beetles trapped were *Pseudoophonus* (syn. *Harpalus*) *rufipes*, *Pterostichus niger* and *Trechus quadristriatus*. No Gastropoda spp. were trapped, but indications for their presence were observed on some cards.

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Do the properties of seeds affect their predation?

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Seed predators are an integral part of agrocoenoses where they contribute to the reduction of weed populations. Seed properties are affecting predation and preference of the seed predators considerably. One of such seed properties is the seed coat, which provides a physical barrier and hinders volatiles to be released from the seeds when these are dry. In this work, we focused on seed preferences of *Taraxacum officinale* and *Stellaria media* by ground beetles (Coleoptera: Carabidae): *Poecilus cupreus*, *Pterostichus melanarius*, and *Anchomenus dorsalis* which are known as omnivores. The seeds were used in three different states - dry, imbibed and with crushed seed coat. The seeds were presented simultaneously in an experimental arena. Consumption was estimated after 30 minutes and 48 hours. Data for *A. dorsalis* were not used for the statistical analysis as the consumption was low. The most preferred seeds by the other two carabids were those of *T. officinale* with damaged seed coat. The total consumption of these seeds was 71.5 % by *P. cupreus* and 71.8 % by *P. melanarius* after 48 hours. The consumption after 30 minutes was 0.1 % by *P. cupreus* and 14.7 % by *P. melanarius*. The seeds of *S. media* were less consumed. This indicates that the consumption was enhanced by either an increase of volatile compounds from the damaged seeds that attracted the beetles, or from shorter handling times.

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Does the increased soil biological activity reduce weed seed survival rates?

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Seed decay has the potential to be considered one little hammer to help farmers in reducing the weed pressure in agroecosystems. However, soil biological processes are often considered only from a soil fertility perspective. With the present work we focused on other positive externalities provided by enhanced soil biological processes. We assume that, by creating conditions that promote soil biological activity, the biological activity of the seed increases and that this reduces survival rate of weed seeds.

In the Core Organic project FertilCrop, "Fertility Building Management Measures in Organic Cropping Systems", tea bags were used to estimate the soil biological activities (measurement of the degradation of green tea and rooibos) and then to estimate if increased soil biological activities increase seed decay. Nylon gauze seed bags filled with 50 seeds of two species with different seed mass, *Polygonum aviculare* (1.90 mg) and *Amaranthus retroflexus* (0.40 mg), were coupled with the tea bags in ten fields in eight different countries across Europe. The seed gauze bags were kept in the soil for different time periods in the different sites, from 60 to 112 days. After collecting the bags, each seed was examined and dissected to determine its fate: germinated, rotten or vital.
The germination rates for the seeds of both weed species were very different in the different trials (*P. aviculare* mean germination varied between 0 and 36%; while *A. retroflexus varied between 0 and 38%*); seed germination for both species tested increased with increasing rooibos degradation, while green tea degradation did not relate to seed germination.
P. aviculare and *A. retroflexus* seeds degradation was positively correlated with rooibos degradation. While indication of soil activities given by green tea degradation seems to show contradictory results compared to the two species degradation trends. It seems that it should be possible to boost seed decay of seed dispersed weed species, like *A. retroflexus* and *P. aviculare*, by conducting agronomical practices that increase soil biological activity, such as cover cropping or reduction of soil tillage in organic farming.

Soil microbial effects on weed seed bank persistence: current knowledge and applications for weed management

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Arable soil contains a soil seed bank of agricultural weeds typically numbering thousands of viable seeds per square metre, and the seeds of many species are capable of long-term persistence while buried at depth. These seeds represent an important carbon and energy source for soil microbes, and accordingly, the potential of using microbe-seed interactions for managing weed seed banks has been variously discussed.

Particularly in the last decade, more evidence has accumulated that illustrates the important role that soil microorganisms in affecting weed seed bank persistence. Much progress has been made regarding our understanding of underlying processes and mechanisms of microbe-seed interaction, and how these are mediated both by abiotic factors and by biotic interactions. Some model systems are now well-understood, and the field is advancing towards practical applications for weed biocontrol.

Based on a review of the recent literature on the subject, to be published in an upcoming book chapter, we have developed a conceptual model showing how the soil microbiome interacts with buried weed seed populations. On the basis of this conceptual model, we illustrate mechanisms of microbial attack and of seed defence, and discuss how seed-microbial interactions might be affected by abiotic environment and biotic interactions. We also give a brief overview over a range of approaches for utilizing interactions between soil microbes and buried weed seeds for agricultural weed management. We also outline future directions of research to close existing gaps in our understanding of microbe-seed interactions, and help develop reliable approaches for weed biocontrol.

Session “Ecosystem Services of Weeds”

How attractive are weeds for pollinators?

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The number of pollinators in agroecosystems worldwide has declined alarmingly in recent decades due to agricultural practices such as the intensive use of pesticides and an increased presence of monocultures. Additionally, an increase in agricultural land use has likely accelerated this decline due to the reduction of natural areas where pollinators can find food and shelter. In such scenarios, weeds play a major role in maintaining biodiversity by attracting pollinating insects.

In order to study the attractiveness of some native weeds to pollinators, a two-year trial was conducted in Viladecans (Catalonia, Spain) in 2.5 x 2.5 m plots with 3 repetitions. The study involved measuring the attractiveness of five different species which were found to attract pollinators in a previous study (*Sonchus oleraceus*, *Papaver rhoeas*, *Daucus carota*, *Malva sylvestris* and *Convolvulus arvensis*) and a combination of all five in equal percentages. Sampling was carried out with visual observations of insect visits to flowers in each plot, twice a week for five minutes in the morning. The observed insects were grouped into seven functional groups: bees, beetles, butterflies and moths, hoverflies, true bugs, wasps and other insects.

There were significant differences between the weeds at the level of attractiveness. *P. rhoeas* and *D. carota* were the weeds that showed the greatest attractiveness to pollinators, with *P. rhoeas* attracting mainly bees and beetles and *D. carota* attracting bees, beetles, hoverflies and true bugs. *C. arvensis* and *S. oleraceus* were the species that showed an overall lower attractiveness for pollinators, the later probably due to the fact that its flowers were only open for a very short period each day.

We can conclude that *P. rhoeas* and *D. carota* were the best species for attracting pollinators because they attracted the greatest proportion of bees, which are important pollinators of crops. *D. carota* also attracted the greatest proportion of hoverflies, whose larvae are important predators of pests. Thus, in highly intensive agricultural environments weeds may act as a substitute for wild plants in ecological terms, helping to maintain insect biodiversity, pollinators and ecosystem functioning.

The use of rare arable plants to enhance ecosystem functions of agro-ecosystems

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Intensification of agricultural land use has led to a decline of biodiversity in farmland. Especially, arable plants adapted to an extensive agricultural management, suffered strongly from agricultural intensification. Nowadays 41% of the arable plant species in Germany are endangered. Knowledge of the functions of this species group could provide both strong arguments for conservation and more sophisticated recommendations for biodiversity management. The objective of our study is therefore to fill this gap and to investigate the following ecosystem functions of rare arable plants: contribution to plant species diversity, impact on flower visitors, beneficial insects and parasites, and their effect on soil fertility, nutrient balance, productivity and landscape aesthetics.

The experiments are carried out in the Munich gravel plain where a total of 100 plots were established on an experimental farm and on ten private farms. A mixture of ten species of rare arable plants were sown at varying crop densities. The effects of rare arable plants on ecosystem functions are compared to commercial flower mixtures. To implement our results into conservation strategies, interviews shall provide information on suitable conditions for farmers to use rare arable plants for conservation.

Preliminary results show that sowing of rare arable plants without crops can attract a similar amount of flower visitors as commercial flower mixtures. Additionally, sowing of rare arable plants increased plant species diversity without reducing the crop yield.

This study indicates opportunities for simultaneous species conservation of rare arable plants and improvement of agro-ecosystems functioning.

The influence of rare arable plants on biological pest control

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The intensification of agriculture since the 1960ties has led to a drastic loss of biodiversity in agricultural landscapes. Arable plant species declined severely and this led to a strong decrease of biodiversity in higher trophic levels. Dwindling numbers of predatory arthropods subsequently reduced the potential of biological pest control. This enhanced the risk of pest outbreaks, as for example aphids, which are seen as one of the most dangerous cereal pests in middle Europe.
The influence of seeding rare arable plants into oats on aphids and their predators was investigated by a factorial field experiment (two factors: seeding arable plants: yes/no, row distance oats: normal/wide). Field investigations were made during flowering and milk ripening stage of the oats. Aphids, parasitized aphids and vegetation dwelling predators (Syrphidae, Coccinelidae) were visually assessed on 100 cereal shoots. Ground-dwelling predators (Carabidae, Staphylinidae, Araneae) have been investigated by using pitfall traps.
The results showed a clear indicator of enhanced associational resistance of the crop mediated through the accompanying arable plants. Plots with seeding of rare arable plants showed marginally lower aphid densities than those without. However, regression analysis showed that with increasing species number (due to background flora) of the arable flora, aphid densities declined. The seeding of arable plants had no significant effect on predator numbers and parasitism rates. Parasitic wasps and aphid numbers showed a negative relationship, which was stronger in plots with seeding of arable plants.
We weren't able to identify the mechanisms which led to the enhanced associational resistance of the crop. Therefore further research is needed to uncover the role of rare arable plants in this context in order to strengthen biological pest control.

Could Brassicaceae weeds contribute to disease management in rapeseed and vegetable crops?

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Weed research has traditionally focused on the negative impacts that weeds have on crop production. However, recent attention has been paid to the positive services that weeds may provide. One regulating service that has received little attention so far is the potential role of weeds in pathogen control. This might be due to our limited understanding of crop-weed-pathogen dynamics in agroecosystems.

In many Brassicaceae crops, seeds are hosts of the necrotrophic fungus *Alternaria brassicicola*, the causal agent of the black spot disease. Synthetic fungicides are used to prevent significant losses in economically important oilseed and vegetable crops. However, there are large differences among Brassicaceae species in terms of sensitivity/resistance to the disease. In particular, a number of weeds (*Sinapis* spp., *Brassica nigra,* etc.) have been described as more or less resistant. The sources of resistance are not well understood.

In 2018, we initiated a study of the diversity of fungi encountered on the seeds of some common weed species that colonize rapeseed and vegetables crops. We asked whether the identity and diversity of the fungi are related to the weed species or/and to the environmental conditions, and whether weeds are hosts of antagonistic fungi, or produce secondary compounds (especially glucosinolates) that limit the growth and transmission of *A. brassicicola* to the seeds.

Potentially, results will promote the integration of Brassicaceae weeds in disease management strategies, as sources of antifungal metabolites or hosts of biological control agents.